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On the Distribution and Biology of the Oceanic Redfish in March 1995

by

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Abstract

The paper describes the areal and depth distribution of the oceanic and the deep-sea *Sebastes mentella* within the EEZ of Iceland, in March 1995. The conditions for an acoustic measurement on oceanic redfish were unfavourable, in March.

Oceanic redfish as well as deep-sea redfish were observed in the entire survey area within the EEZ of Iceland. The two species were much more mingled at this time of the year compared with June/July. Females of oceanic redfish were slightly more advanced in the development of the ovaries than females of deep-sea redfish.

Some informations on the stomach content is given. External and muscular abnormalities observed on oceanic and on deep-sea redfish are described.

Introduction.

The fishing on oceanic redfish in the Irminger Sea commenced in 1982. Iceland joined in this fishery in 1989. Since then, it has been of increasing importance for the Icelandic fisheries. A considerable effort has been put into research on this stock which migrates between the Exclusive Economical Zones (EEZs) of Iceland and Greenland and international waters. Priority was put on assessing the stock size by acoustic methods which seemed to be best suitable for this pelagically living stock. Several acoustic surveys have been conducted (e.g. Pavlov et al., 1989; Magnússon et al., 1992a, 1992b, 1994; Anon., 1994). All these surveys have been carried out during the summer period (June-July). Additional surveys have been conducted to examine the feasibility of acoustic assessments (Anon., 1994) and for testing acoustic equipments (Rätz 1995). Trials carried out in the months April and May, by the USSR and by Iceland have not been very successful because of various disturbance of the echo recordings of oceanic redfish. Successful acoustic assessments have only been carried out during the summer time (June/July), i.e. during the feeding period of redfish which follows the "spawning" period. However, none of these surveys have covered the total area of distribution. Although the acoustic assessments during summer time seem to be reasonably reliable they do not give any information on the quantitative distribution at other times and in other areas.

Knowing that this straddling stock inhabits the EEZ of Iceland during the "spawning" period (30 % of the Icelandic catch of oceanic redfish in 1994 was taken within the EEZ of Iceland), the Icelandic authorities considered it very urgent to quantify the proportion of this stock within the EEZ of Iceland and decided to finance a special cruise where the attempt should be made to carry out an acoustic assessment of the stock within the Icelandic EEZ in winter time prior to the "spawning" period. From earlier research experiments and by the fisheries it was assumed that oceanic redfish were abundant within the Icelandic EEZ, in February/March. Therefore, it was decided to conduct the survey in March. The survey area, cruise tracks and stations are shown in Fig. 1.

Material and methods.

The survey was carried out by the Marine Research Institute (MRI), Iceland, with the chartered freezer trawler "Víðir", EA 910 (69.4 m, 865 GT and 3274 hp) during the time period 07-21 March 1995. A 38kHz Simrad EK500 split beam echo sounder and a BI500 postprocessing system from the research vessel "Árni Friðriksson" was installed on "Víðir" and was used for the acoustic data collection (Bodholt et al.,1989, and Foote et al., 1991).

An attempt was made to calibrate the acoustic equipment prior to the survey but failed because of unfavourable weather conditions and echoes from fish and other organisms. The settings of the equipment used during the survey are shown in Table 1.

The trawl used was a Gloria 2048 midwater trawl equipped with SIMRAD headline sonar. The vertical opening was mostly about 90 m. A total of 30 hauls were taken in different depths. The temperature of the towing depth was recorded. The catches were sorted according to species and treated separately. Length, weight, sex, maturity, external and muscular abnormalities were recorded and otoliths and scales collected from selected samples. The external abnormalities were grouped into spots (black, red and mixed ones), in infestation by *Sphyrion lumpi* and in leasons caused by the ectoparasite. The melanophorial discolorations of the muscular tissue were grouped into light, medium and severe by visual estimation. The maturity stages are defined according to the scale presented in the Report of the Study Group on Redfish Stocks, 1993 (Anon., 1993).

Results

The conditions for acoustic measurements on oceanic redfish were unfavourable for several reasons. The vertical distribution of the oceanic redfish was deeper and wider than during the summer time (June/July). Therefore, the redfish was almost constantly mingled with the scattering layer of other organisms, in depths of 300-700 m. The scattering layer which consists of many deep-sea fish species or groups such as *Myctophidae, Paralepididae, Chauliodus sloani, Stomias boa ferox* and *Serrivomer beani*, and of other organisms had a much wider vertical and more irregular distribution in the survey area, in March than in the Irminger Sea during summer time. Therefore, it was very difficult to trace echoes from redfish and impossible to obtain a reliable estimate of echo abundance. Fig. 2 is a typical example of an echogram of the survey showing the scattering layer from 300 m depth and down to more than 700 m depth. Since the acoustics were unsuitable for assessment purposes, no further analyses on the acoustic data were carried out.

Although a reliable acoustic assessment could not be achieved it was decided to continue the cruise as a trawl survey. Hauls were taken throughout the survey area but at different depths. The number of hauls was limited because they are very time consuming and the survey time limited.

Oceanic redfish was observed throughout the survey area. Fig. 3 shows the relative abundance of oceanic redfish (kg/trawling hour) regardless of depth. The oceanic redfish was most abundant in the southernmost part of the area. In almost all the hauls the catch consisted of a mixture of oceanic and deep-sea redfish in an appr. average rate of 3 to 1 decreasing with increasing depth (Fig. 4). The distribution charts (Figs. 3 and 5) are based on the hauls but only one depth was fished at each station. Thus, the distribution pattern must not necessarily reflect the true variation in the density distribution.

The composition of the catches in the time period prior to the release of the larvae, i.e. in April/May, showed that females already outnumbered the males at some locations. Females were most abundant in the southern part of the survey area. However, there were also some density patches in the more northerly part of the survey area (Fig. 6).

The maturity stages of both oceanic and deep-sea redfish were similar (Table 2). Almost 89 % of the females of both species were of stage III. The splitting of stage III into a, b and c, i.e. the three stages of egg- and embryo development allow for some comparison of the two stocks in the period of "spawning". Of the oceanic redfish, 3.9 % and 2.1 % of the deep-sea redfish were in the actual stage of "spawning" (IIIc). Further, the somewhat higher percentage of stage IIIb and the lower one of stage IIIa for the oceanic redfish indicate that the females of this species are slightly more advanced in the development of the ovaries which points to an earlier "spawning", however, with great overlapping in time. The percentage distribution of stages II (and IV) show even more pronounced the earlier development of the gonads of male oceanic redfish indicating a somewhat earlier mating time of this species, at least in 1995.

The length distribution of oceanic and of deep-sea redfish is demonstrated in Fig. 7. The overall mean weight of oceanic redfish was 661 g and of deep-sea redfish, 1005 g.

An overview of the observations on the stomach content of oceanic and deep-sea redfish is given in Table 3. The percentages of everted and of empty stomachs of both species are nearly identical. Only 10 % of the stomachs of oceanic redfish and 9.4 % of the stomachs of deep-sea redfish were recorded with content but the volume was generally little, in particular for deep-sea redfish.

The diet of oceanic redfish was somewhat more variable than of deep-sea redfish. Euphausids dominated in the diet of both species. However, fish and fish remnants were much more frequently observed for deep-sea redfish but on the other hand, amphipods and squids were lacking which ranged second and third in the diet of oceanic redfish. Some of the food components observed in the diet of the species in summer time were totally lacking, such as copepods, chaetognaths and medusae, in March.

About 49 % of oceanic redfish were recorded with abnormalities (Table 4). Females were much more infested than males (34 % and 15 %, resp.). The infestation by *Sphyrion lumpi* and by leasons caused by this ectoparasite dominated in the record of external abnormalities and it was much higher for females than for males. Black spots were the most common group of the spot categories, both on males and on females.

Almost half of the examined oceanic redfish (47.3 %) showed some discoloration of the muscular tissue. However, it was more equally distributed between the sexes than the external abnormalities. Although in most cases, the discoloration was light, 6.4 % of the fish were estimated with severe and 9 % with medium pigmentation.

Deep-sea redfish showed by far less external abnormalities than oceanic redfish although females were also more infested than males. Like for the oceanic redfish, the infestation by *Sphyrion lumpi* and leasons caused by it dominated. Of the spots, the group of red spots were most common. About 93 % of the examined deep-sea redfish were recorded without any discoloration of the muscular tissue. Only 1% were categorized as medium and 0.6 % as severely pigmented.

Of the body sections (head, back, abdominal and tail) the abdominal section was by far the most infested one especially for females. As previously observed, *Sphyrion lumpi* and leasons caused by it mainly grouped around the anus. Generally, the body sections of males were much less infested than those of females except for the head section. This was observed for both species. (Fig.8).

Discussion and conclusions

The acoustic survey which was carried out in June/July 1994 (Magnússon et al., 1994) reported that less than 3% of oceanic redfish were observed below 350 m depth. It is obvious from the results of this survey, in March 1995 that the oceanic redfish inhabit deeper layers at this time of the year since the greatest densities were observed in 400 to 600 m depth according to the trawl samples. The depth range of the deep-sea redfish was, on the other hand, wider at this time of the year since the species was also frequently observed in shallower layers than in June-July when it is almost exclusively absent in depths less than 500 m. It can, however, be concluded that the aggregations were greater in the southern part of the survey area. Oceanic redfish was observed throughout the whole survey area at this time of the year and oceanic redfish were recorded farther to the north in this region than previously assumed. The distribution of females underline further the patchiness of "spawning" which has been observed previously (Magnússon 1983). The percentage of oceanic redfish with stomach content was about three times lower, in March, than in the summer time (Magnússon et al., 1994). Also, the diet was less variable. This might be related to the season and to the approaching time of releasing the larve. The overall infestation rate of oceanic redfish in the Irminger Sea was almost the same in March, 1995, as in June/July 1994 (Magnússon et al., 1994b) but the infestation rate of *Sphyrion lumpi* and leasons caused by it was considerably lower (30.4 %) compared to the observations in March 1995 (43.4 %). Deep-sea redfish were much less infested than oceanic redfish as has already been pointed out earlier (Magnússon et al., 1994b).

With respect to the objectives of the survey, the main conclusions are that: Acoustic measurements cannot be applied for assessment purposes on oceanic redfish, in March, because of the vertical distribution and the mingling with the scattering layer. Oceanic redfish was distributed throughout the whole survey area. Oceanic redfish seem to inhabit mainly depths of 300 to 650 m, in March, compared with 100 to 350 m depth, in June/July.

Deep-sea redfish were observed in shallower waters, in March, compared to June/July.

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Table 1. Instrument settings during the redfish survey in March 1995

Echo sounder/integrator	Simrad EK500/BI500
Frequency	38 kHz
Transmitter power	2000 w
Absorption coefficient	10 dB/km
Pulselength	1.0 ms
Bandwidth	3.8 kHz
Transducer type	ES38-B
2 way beam angle	-20.6 dB
Sv-transducer gain	26.5 dB
TS-transducer gain	26.7 dB
Angle sensitivity	21.2
3 dB beamwidth	7.1 dg
Alongship offset	0.02 dg
Athw. ship offset	-0.01 dg
Intergrator threshold	-80 dB
Sound speed	1470 m/s

Table 2

Maturity stages of oceanic and deep-sea redfish, off SW and W Iceland, in March 1995

	Oceanic redfish										
	Females							Males			
Mat.St.	I	II	IIIa	IIIb	IIIc	IV	Total	I	II	IV	Total
No.	23	33	88	767	39	57	1007	11	763	113	887
%	2,28	3,28	8,74	76,17	3,87	5,66		1,24	86,02	12,74	
	Deep sea redfish										
	Females							Males			
Mat.St.	I	II	IIIa	IIIb	IIIc	IV	Total	I	II	IV	Total
No.	5	7	84	442	13	59	610	4	317	148	469
%	0,82	1,15	13,77	72,46	2,13	9,67		0,85	67,59	31,56	

Table 3.
Observations on the stomach content

	Oceanic redfish		Deep-sea redfish	
	N	%	N	%
Total	1892		1152	
Everted	1389	73,4	854	74,1
Empty	314	16,6	190	16,5
w.Content	189	10,0	108	9,4
little	73	3,9	68	5,9
medium	58	3,1	20	1,7
much	58	3,1	20	1,7
	frequ.	%	frequ.	%
Euphaus.	66	55,9	28	54,9
Amphip.	19	16,1	0	0,0
Shrimps	4	3,4	2	3,9
Squids	4	3,4	1	2,0
Gastrop.	9	7,6	0	0,0
Fish	6	5,1	4	7,8
Fish remn.	8	6,8	15	29,4
Digest.	2	1,7	1	2,0

Table 4
Incidence of external and muscular abnormalities

	Oceanic redfish				Deep-sea redfish			
	Males	Females	Total		Males	Females	Total	
No.of exam.fish	886	1006	1892		508	644	1152	
No.of fish w.abnorm.	281	645	926		95	222	317	
%	14,9	34,1	48,9		8,2	19,3	27,5	
external				Ratio				Ratio
black spots	114	263	377	19,9	18	30	48	4,2
red spots	63	125	188	9,9	23	77	100	8,7
mixed spots	7	134	141	7,5	0	19	19	1,6
remnants	126	318	444	23,5	46	94	140	12,2
Sph.lumpi	89	288	377	19,9	30	91	121	10,5
muscular								
no pigment.	472	526	998	52,7	475	599	1074	93,2
with pigment.	413	481	894	47,3	33	45	78	6,8
light	278	324	602	31,8	25	35	60	5,2
medium	87	84	171	9,0	6	5	11	1,0
severe	48	73	121	6,4	2	5	7	0,6

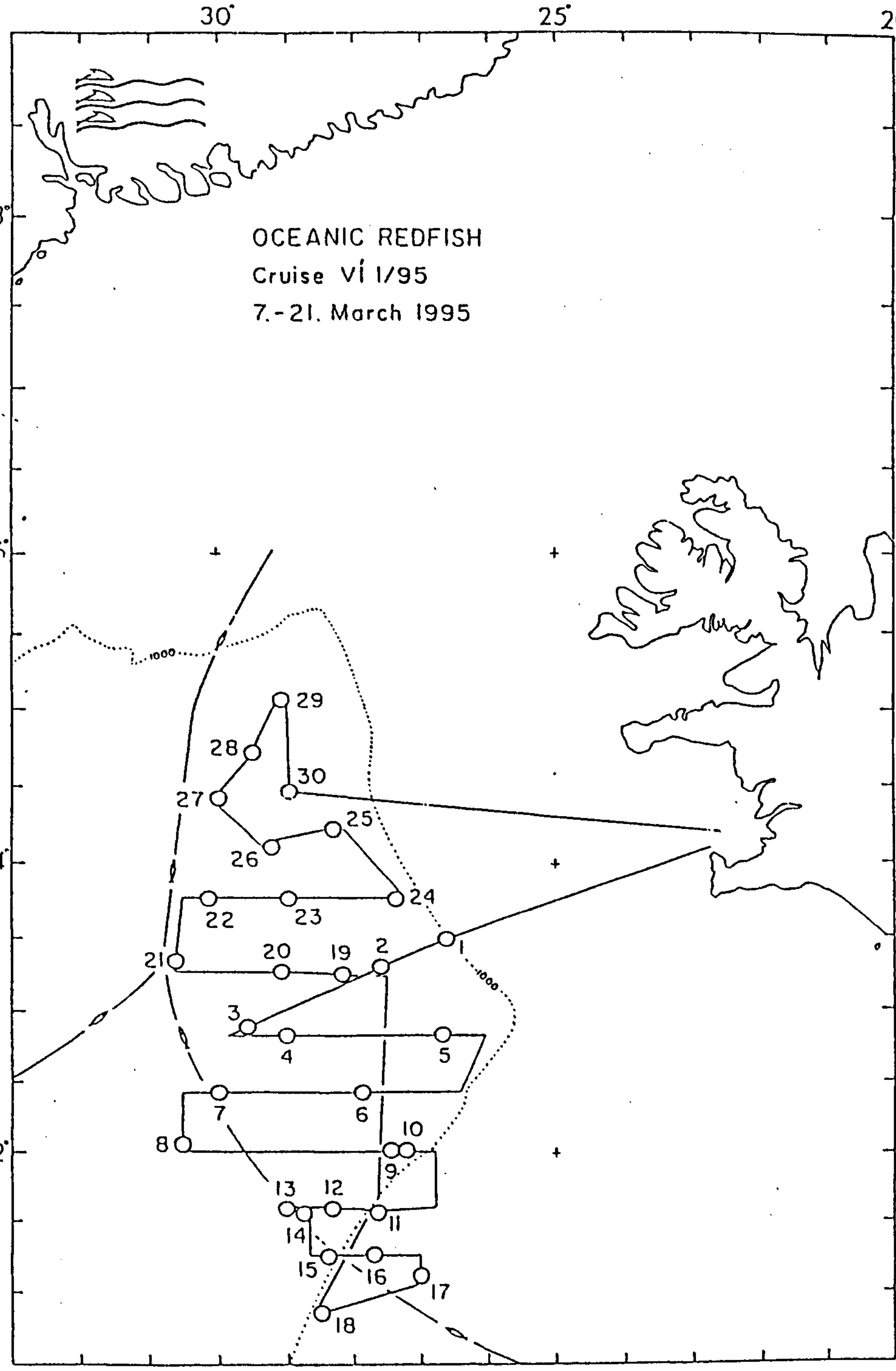

Fig. 1. Cruise tracks and trawl stations.

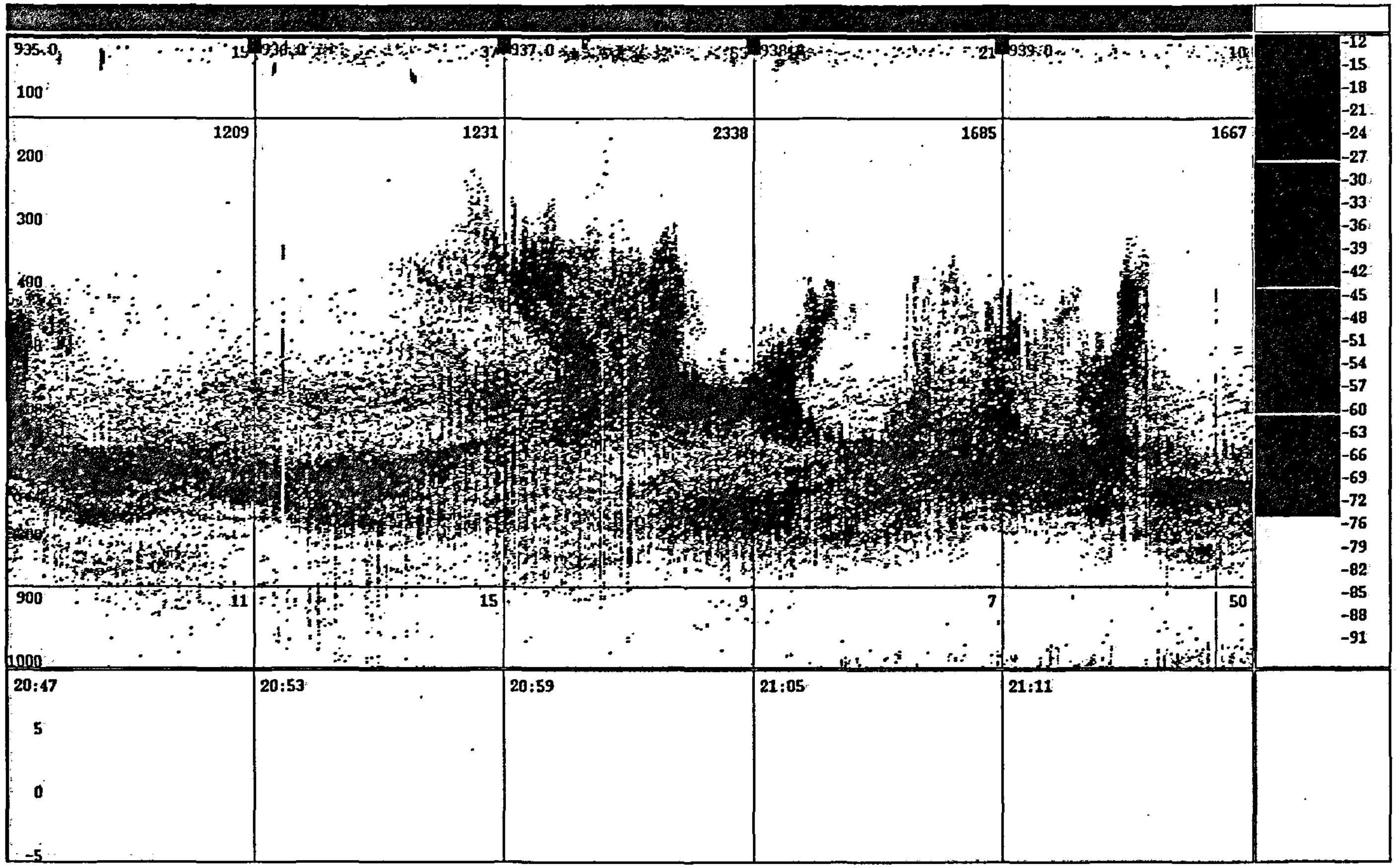

Fig. 2. A typical echogram obtained during the survey.

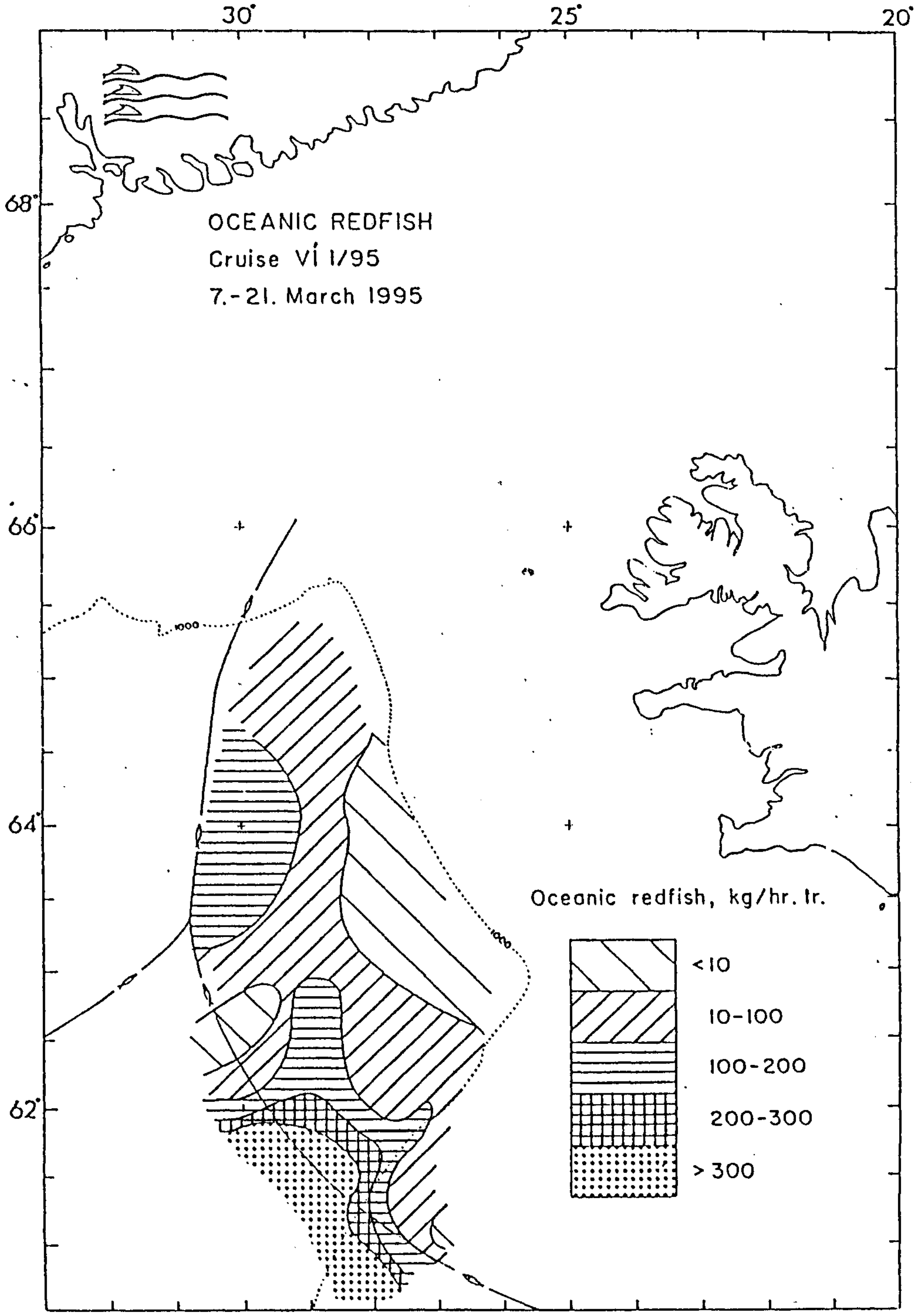

Fig. 3. Oceanic redfish. Distribution in kg pr. tr. hr.

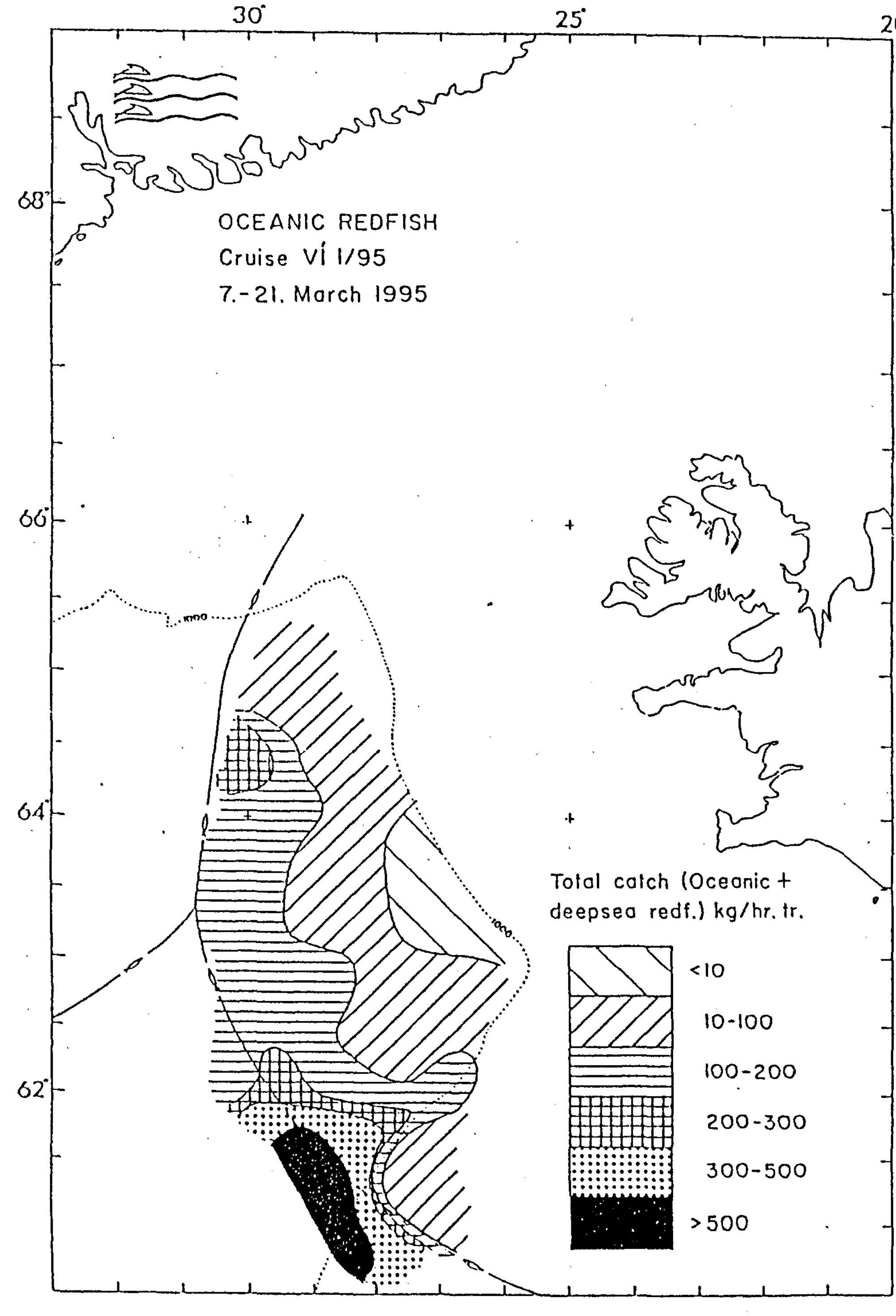

Fig. 5. Oceanic redfish and deep-sea redfish combined (kg. pr. tr. hr.).

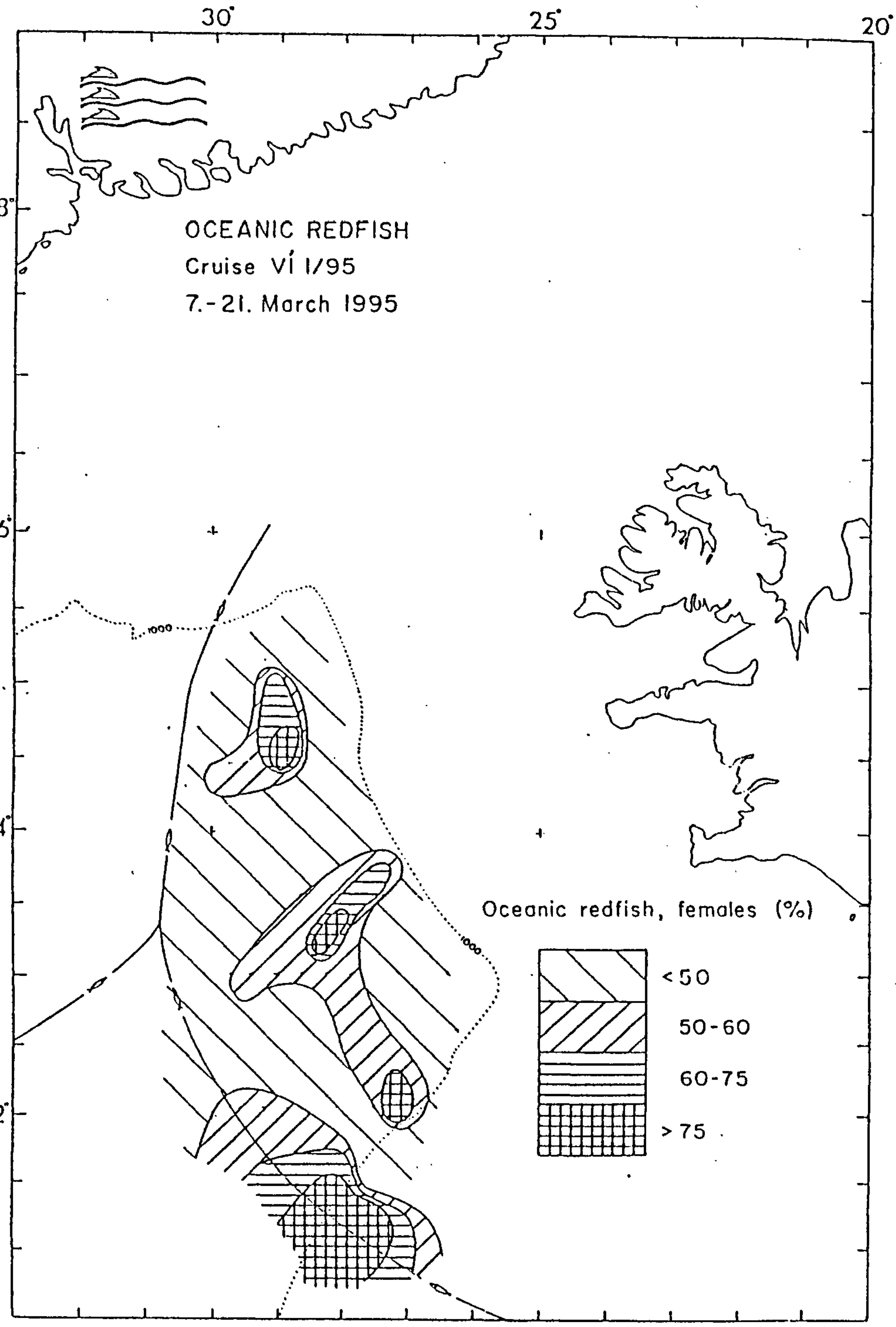

Fig. 6. Oceanic redfish. Proportion of females (%).

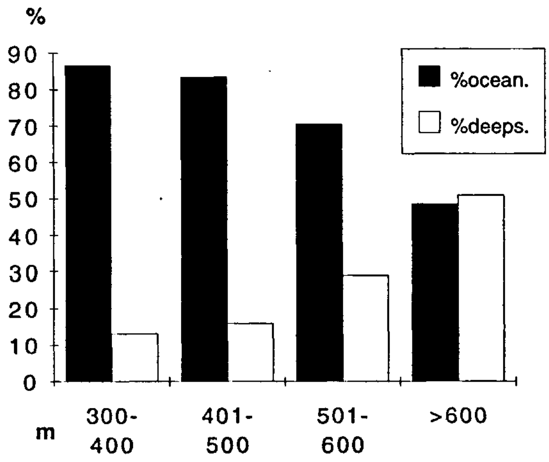

Fig. 4. The proportion of the two types of redfish in the catches by depth categories.

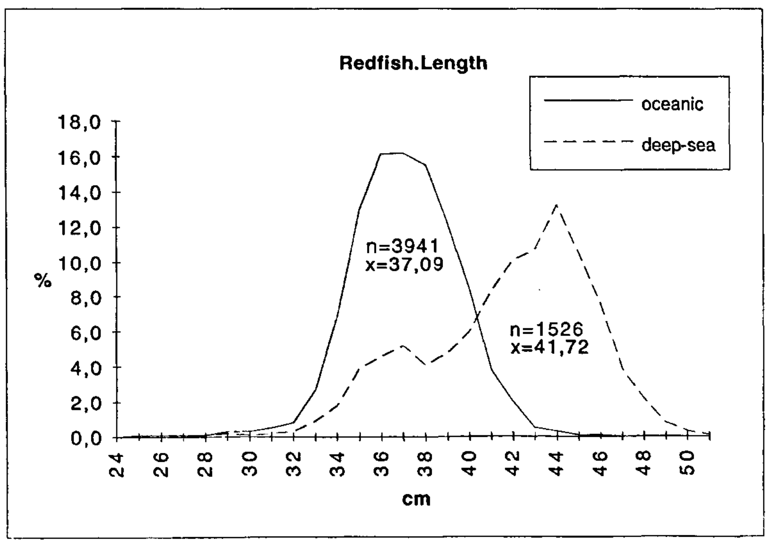

Fig. 7. Length distribution of oceanic redfish during the survey.

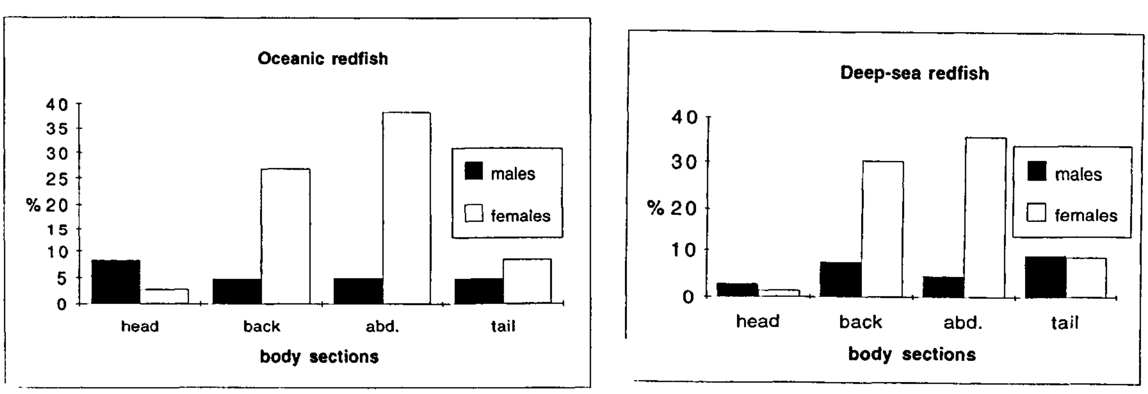

Fig. 8. Proportional distribution of external abnormalities by body sections.